

CASE STUDY 3
Faro
Portugal







CS3

URBAN WASTEWATER

Faro Utrecht Portugal The Netherlands



The CS3 Kaumera extraction installation (aka KEI) will demonstrate the feasibility of implementing innovative technologies to treat and valorise urban wastewater and transform wastewater treatment plants (WWTP) to resource recovery facilities, contributing this way to circular economy in the wastewater sector.

The proposed next generation of urban wastewater treatment plants (WWTP) includes several innovative resource recovery strategies. Primarily, the biopolymer Kaumera Nereda® gum (Kaumera) is extracted from granular sewage sludge in a transportable pilot installation with a capacity of 5000 L granular sludge per day (see scheme below). Kaumera has various high value agricultural and industrial applications. The pilot will be tested and optimized in Utrecht and then transported to Faro/Olhão WWTP (Portugal) for further development, optimization and operation. Green gas production using alkaline organic rich residuals from the extraction is investigated on bench scale in a 5L reactor. Specially adapted microorganism can perform at high pH conditions. The integration of phosphorus and nitrogen recovery is studied for increasing circularity of the extraction process further.



Key innovations

Kaumera Nereda[®] Gum extraction from granular Nereda® sludge: Kaumera is a valuable biopolymer with wide ranges of possible applications in agriculture, e.g., as composite, in the textile industry and as flame retardant. In Faro/Olhão WWTP, the main application foreseen for Kaumera will be as Fertilizer coating (slow release), bio-stimulant (root coating or direct application) and water absorber (direct application) in agriculture. It is a sustainable and fully degradable green alternative to other polymers. Additionally, nitrogen and phosphorus is partly recovered from the wastewater as integral part of the polymer. The transportable extraction allows the expansion of Kaumera extraction technology to European countries beyond The Netherlands.

Integration of nitrogen and phosphorus recovery in the Kaumera extraction process: This includes modelling and lab experiments to determine, for the first time, mass flows and speciation of nitrogen and phosphorus during extraction. This knowledge will be the foundation for defining nutrient recovery strategies to increase the resource recovery from wastewater.



Alkaline Fermentation: Organic rich waste sludge from the Kaumera extraction has a high pH and salt content. Fermentation at these conditions is challenging but is rewarded with a very high methane yield and almost pure methane stream. Specially adapted microorganisms from soda lakes are used. The volume of waste is reduced and at the same time a substitute for natural gas is produced in a sustainable way. Another step towards higher circularity.



Main challenges

Kaumera Nereda® Gum extraction from granular Nereda® sludge: Potentially adaption of the extraction process to sludge properties in Faro (warm climate, different wastewater characteristics etc.). Can Kaumera Nereda® Gum extracted from Faro be used for the same application as cold climate Kaumera?

Integration of nitrogen and phosphorus recovery: What is the phosphorus / nitrogen speciation? How can the recovery be integrated in the extraction process without negative effects on Kaumera extraction? Which products can be produced from nitrogen / phosphorus?

Alkaline Fermentation: How can a continuous process be operated using the alkaline sludge residuals (retention times, substrate feeding rate etc.).



Outcomes

Kaumera extraction strategies and application advices for other wastewater conditions then in Netherlands e.g. temperature or salt content. Strategies for integrating phosphorus and nitrogen into the Kaumera extraction process.



Experiences with a bench scale alkaline fermenter will outline the further upscaling strategy.



Expected impact on society

CS3 contributes to change the perspective of urban wastewater treatment: the society should no longer think about urban wastewater as a residue that must be treated to be discharged, but as a valuable raw resource that can be processed to recover valuable resources like biopolymers, nutrients, and energy. In CS3 we will demonstrate, at pilot scale, that it is possible to implement circularity in an urban wastewater treatment plant, and we will show to the society the technical, economical, social and environmental feasibility of the proposed solution. This CS (and all the project) is aligned with the SGD 6 (sustainable development goal 6) of the UN, which aims to ensure availability and sustainable management of water and sanitation for all.

Business opportunities (market map)

The business opportunities are based on the extraction of Kaumera Nereda® gum that is recovered.

The recovery of Kaumera from urban wastewater contributes to the circularity of the business model, and many new applications have been identified that could result in new commercial activities. This investment can likely be recovered through the revenue stream (i.e. Kaumera). The main barriers are related to the scale-up and commercialization process for the various applications.









Chemicals reuse



Contact







TU DELFT

Phillip Wilfert p.k.wilfert@tudelft.nl

ACCIONA

Ma. del Mar Mico Reche mariamar.mico.reche@acciona.com ADA

António Martins antonio.m.martins@adp.pt





ADA

Sara Barreto s.barreto@adp.pt